



Aquatic and marsh plants from the Recôncavo basin of Bahia state, Brazil: checklist and life forms

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Abstract: Aquatic and marsh plants are those that have the capacity to withstand a continuous or periodic submersion in water, at least of their roots. Such plants are thus able to occupy environments that are at least periodically waterlogged. The knowledge about this plant group is still rather incomplete for various parts of Brazil including the Northeast. The present study was conducted in Bahia state, through collections in 20 municipalities within the Recôncavo basin between 2009 and 2015. All species were classified across six life forms. We report 316 species in 206 genera and 71 families, including 11 fern species, with helophytes and emergent being the commonest ones. Collection efforts in aquatic environments in the Recôncavo region added nine families of angiosperms to those already reported in previous studies of such plants in Northeastern Brazil. The region presents a wide variety of aquatic and marsh plants and the respective habitats play an important role in the conservation/maintenance of biodiversity and especially of water bodies in Eastern Bahia.

Key words: wetland flora; Cyperaceae; helophytes

INTRODUCTION

Aquatic and marsh plants are those that have the capacity to withstand a continuous or periodic submersion in water, at least of their roots. Such plants are thus able to occupy environments that are at least periodically waterlogged (Amaral et al. 2008). This is a rather broad concept where even the terms “aquatic” and “marsh” are not strictly defined, and where

intermediate conditions are always present. Aquatic plants are also referred to as macrophytes, though there is much disagreement on the use of this term (Cook 1990; Ferreira et al. 2014).

The term “aquatic macrophytes” was first used by Weaver and Clements (1938), who defined them as herbaceous plants growing in water, on waterlogged land, or even in water-saturated soils. Raunkiaer (1934) called water-submerged plants, or those with floating leaves, hydrophytes. Iversen (1936) proposed the term “limnophytes” to describe exclusively higher freshwater plants. Cook et al. (1974) and Cook (1985) used the term “aquatic macrophytes” for all plants whose active photosynthetic parts are permanently, or periodically, submerged or floating on water and which are visible to the naked eye.

In our study, we use the term macrophytes for superior aquatic and marsh plants that spend all or part of their life cycle in water or in a periodically flooded substrate, and that are usually found in ponds, lakes, streams, rivers, on their margins, or nearby.

Because of the wide variation in the distribution of plants in an aquatic environment, several authors have also classified them according to their life forms or habit. On the basis of their position in relation to the water surface and degree of adaptation to the environment they may be divided into free-floating, fixed-floating, free-submerged, fixed-submerged, emergent, or helophytes (Cook 1990). Plants of these groups are distributed along the margins of the waterways in an organized manner, forming division zones from the margins of the body of water to its interior, from the emergent plants to the fixed-submerged ones (Cook 1990; Ferreira et al. 2014).

Brazil has the largest hydrographic network in the world, with the aquatic ecosystems of its rivers and lakes (permanent or temporary) often showing unique characteristics and considerable endemism (Bove et al. 2003). In order to guarantee their preservation as well as improve their management, the study of plants in such environments should be considered of primary importance (Amaral et al. 2008).

Floristic approach has been prevalent in the surveys of aquatic plants in Brazil (Ferreira et al. 2014), carried out for the most part in reservoirs (Pompeo and Moschini-Carlos 2003) of the Southeast, Midwest and Northeast (França et al. 2003; Neves et al. 2006; Amaral et al. 2008; Pivari et al. 2008; Cervi et al. 2009; Pivari et al. 2011; Kufner et al. 2011; Lima et al. 2011; Meyer and Franceschinelli 2011; Valadares et al. 2011; Araújo et al. 2012). These studies demonstrate taxonomic diversity of aquatic plants as well as different methods of morphological adaptation to the aquatic environment (Esteves 1998; Alves et al. 2011.). However, there are large areas of the Brazilian Northeast that still lack basic information such as species lists of aquatic plants (Moura-Jr. et al. 2013) and data sets on their ecology.

The objective of our study was to provide a floristic survey of the freshwater environments of the Recôncavo basin of Bahia, Northeastern Brazil. Such habitats of this region of Bahia are floristically poorly studied and we consider this contribution as a start for further studies of aquatic environments of the coastal regions of the state.

MATERIALS AND METHODS

Study area

The Recôncavo basin of Bahia comprises an area of 11,200 km² and encompasses 20 municipalities (Cabaceiras do Paraguaçu, Cachoeira, Castro Alves, Conceição do Almeida, Cruz das Almas, Dom Macedo Costa, Governador Mangabeira, Maragogipe, Muniz Ferreira, Muritiba, Nazaré, Santo Amaro, Santo Antônio de Jesus, São Felipe, São Félix, São Francisco do Conde, São Sebastião do Passé, Sapeaçu, Saubara, and Varzedo) (SEI 2015). It is part of the Atlantic Forest Phytogeographic Domain, being bordered in the west by the Caatinga Domain. Its soil is commonly known as “massapê baiano”, being relatively fertile. The climate is quite varied due to the differences in relief, with coastal areas reaching annual mean temperatures of about 23°C, and the total amount of rainfall exceeding 1,500 mm. Annual mean temperatures inland vary from 18°C in the higher-lying areas and 22°C in lower areas, with an annual rainfall of 1,000 mm (SEI 2015).

Floristic inventory: the inventory was performed during periodic visits to the lotic and lentic aquatic environments in 16 of the 20 municipalities in the Recôncavo basin (Figure 1) from 2009 to 2015 through

the rainy and dry seasons.

All collected plant materials were prepared in accordance with the methodology proposed by Mori et al. (1985) and a voucher for each species was deposited at the Herbário do Recôncavo da Bahia (HURB, abbreviation according to Thiers 2015). Plant family classification is that of the APG III (2009) and species nomenclature is that found in the Plant List of Brazil (Lista de Espécies da Flora do Brasil 2015).

Ecological groups were determined according to Cook (1990), using the following categories: helophytes, fixed-floating, free-floating, emergent, epiphytes, fixed-submerged, and free-submerged. Lorenzi (2008) and Moreira and Bragança (2011) were used to recognize the ruderal species.

Taxa identifications were made using specific literature, specimens studies at HURB and HUEFS herbaria (Herbarium of the State University of Feira de Santana, Bahia), and by sending duplicates to plant experts for determination. Photographic records have been taken for all collected species. They will eventually be used in the construction of a multiple-access interactive key for aquatic and marsh plants of the Recôncavo basin in Bahia (<http://www2.ufrb.edu.br/chave-plant-aq/>).

RESULTS

Floristic composition: a total of 316 plant species, distributed in 206 genera of 71 families have been collected (Table 1), with 11 species of ferns and lycophytes, distributed in eight genera and six families. *Anemia* and *Salvinia* are represented by three and two species, respectively.

Angiosperms are represented by 305 species, in 198 genera and 64 families. Cyperaceae was the most diverse family (39 species), followed by Poaceae (29), Fabaceae (25) and Asteraceae (22). About 80% of angiosperm families had less than five species in the studied environments. The most diverse genera with the highest number of species were *Eleocharis* (12 species) and *Cyperus* (9). About 33%, or 99 of the 295 collected species, were ruderal plants.

The predominant life form was helophyte, with 68.7% of the species, followed by emergent (24%), with the rest of life forms representing less than 3% (Figure 2). Among the helophyte plants the most representative families were Fabaceae (22 species), Asteraceae (18), and Cyperaceae (16), while the most representative genera were *Cuphea* (five species), *Cyperus* (four), and *Ludwigia* (four).

Among the emergent plants Cyperaceae (26 species) and Poaceae (6) were the dominant families, with *Eleocharis* (10 species) and *Cyperus* (7) the most diverse genera. Among the fixed-floating plants, Nymphaeaceae was predominant, with four species of *Nymphaea*. The best represented families of the free-floating plants were Salviniaceae (three

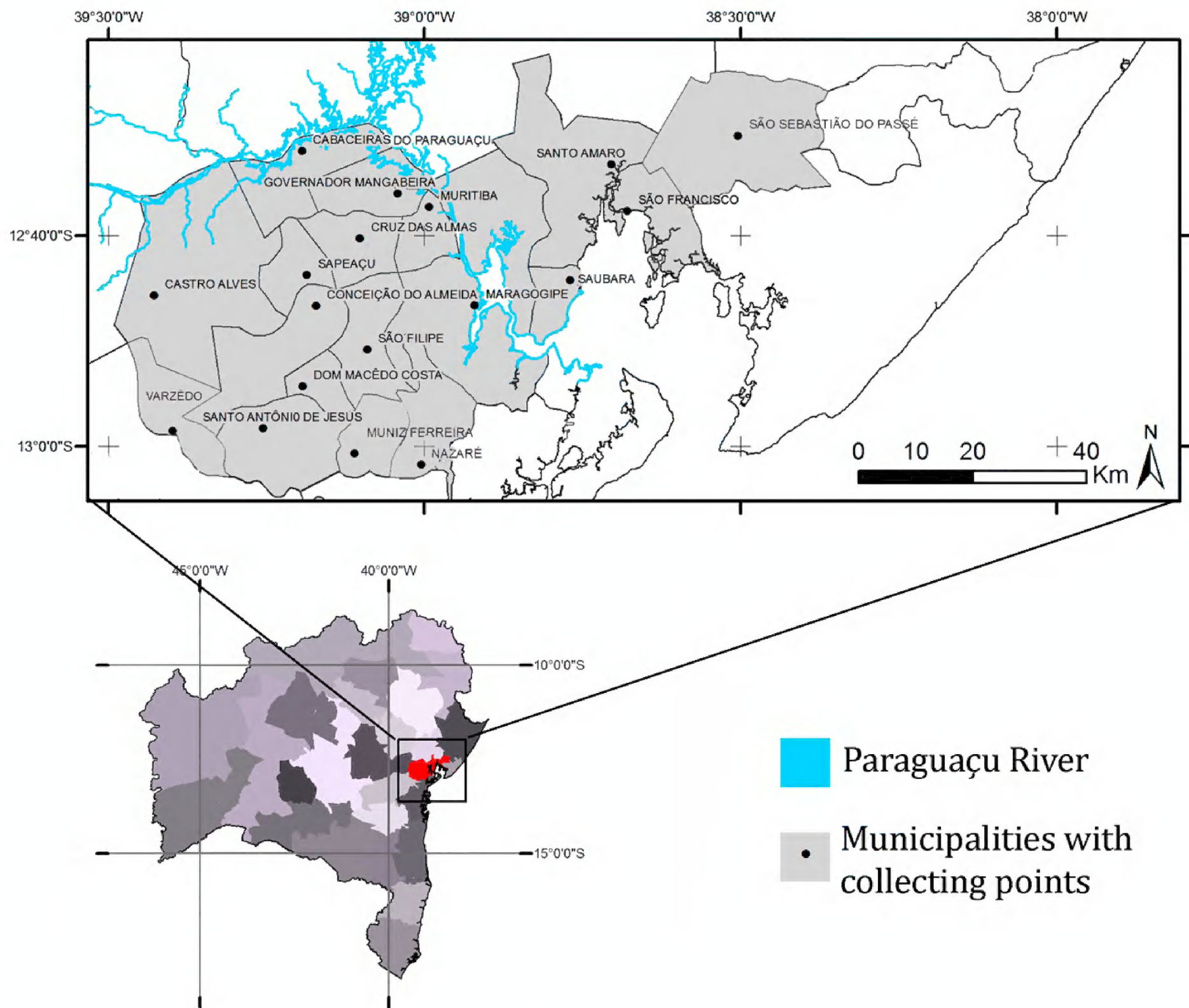


Figure 1. Map of the Recôncavo basin of Bahia. Sampled municipalities are indicated.

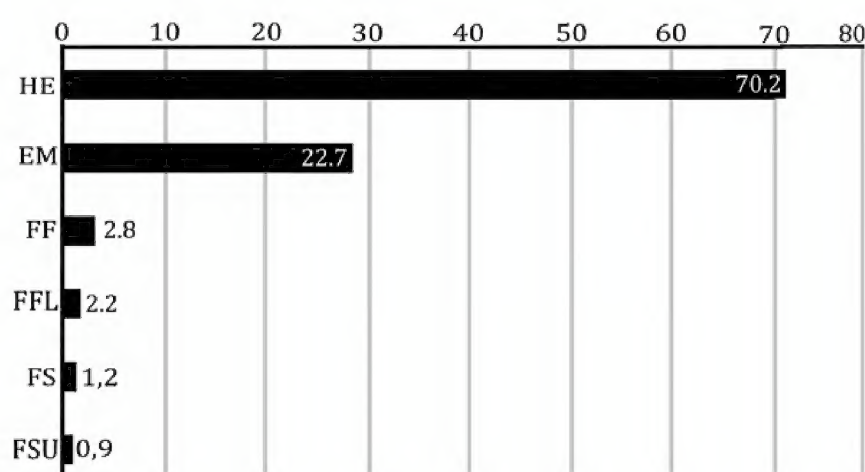


Figure 2. Percentages of life forms of the aquatic species occurring in the Recôncavo basin of Bahia. HE = helophytes; EM = emergent; FF = free floating; FS = free submerged; FFL = fixed floating; and FSU = fixed-submerged.

species) and Araceae (two). In the fixed-submerged category, Hydrocharitaceae was the most important family, with two species, whereas Lentibulariaceae was dominant in the free-submerged category, with two species of *Utricularia*. Among collected plants, *Najas conferta* was the only species with submerged flowers.

Examples of collecting locations and of some of the collected species are illustrated in Figure 3.

DISCUSSION

The aquatic flora of the Recôncavo basin of Bahia is characterized by its high species richness representing about 50% of the 500–600 species estimated for the aquatic environments in Brazil (Agostinho et al. 2005). The present work showed values higher than those recorded both in spot inventories, with 28 to 125 species (França et al. 2003; Neves et al. 2006; Pivari et al. 2008; Kufner et al. 2011; Lima et al. 2011; Valadares et al. 2011; Araújo et al. 2012), and in inventories of larger geographic areas, with a species richness of 70–184 (Cervi et al. 2009; Pivari et al. 2011; Meyer and Franceschinelli 2011).

These results indicate that the region is of fundamental importance for the understanding of ecological processes associated with the aquatic environment, since there is a direct relationship between species richness and its ecosystem functionality (Maestre et al. 2012).

Despite the high degree of species richness, both at species and family levels, the Recôncavo basin of Bahia shows that Cyperaceae is the predominant family (39 spp.), with Poaceae (29 spp.), Fabaceae (25 spp.), and Asteraceae (21 spp.) also prominently represented. The predominance of these families was also observed in several studies involving aquatic plants (França et al. 2003; Neves et al. 2006; Pivari et al. 2008; Cervi et al. 2009; Pivari et al. 2011; Kufner et al. 2011; Lima et al. 2011; Meyer and Franceschinelli 2011; Valadares et al. 2011; Araújo et al. 2012).

In the generic level, species richness varies among the reviewed studies. Apart from the common generic predominance of Cyperaceae (*Cyperus*, *Eleocharis*, and *Rhynchospora*) (França et al. 2003; Cervi et al. 2009; Lima et al. 2011; Meyer and Franceschinelli 2011; Valadares et al. 2011), several studies showed an elevated species richness of *Ludwigia* (Onagraceae) (Neves et al. 2006; Pivari et al. 2008; Pivari et al. 2011; Araújo et al. 2012), *Baccharis* (Asteraceae) (Kufner et al. 2011), and *Utricularia* (Lentibulariaceae) (Moreira et al. 2011).

With the increased collection of aquatic and marsh plants in the Recôncavo basin of Bahia, several important records were made, such as the first records for Bahia state of *Enydra anagallis* Gardner (Asteraceae), *Oxypetalum tubatum* Malme (Apocynaceae), *Caperonia palustris* (L.) A.St.-Hil. (Euphorbiaceae), *Lindernia crustacea* (L.) F.Muell. (Liderniaceae), *Peltaea obsita* (Colla) Krapov. & Cristóbal (Malvaceae), *Ludwigia peploides* (Kunth) P.H.Raven (Onagraceae), *Diodia macrophylla* K.Schum. (Rubiaceae); a re-collection of *Mecardonia procubens* (Plantaginaceae); a new species of *Eleocharis* (Cyperaceae); and an expansion of the distribution range for *Heteranthera rotundifolia*, previously associated with the semi-arid areas of Bahia (Sousa and Giulietti 2014). These findings confirm the

view that regular collections over longer period of time (2009-2015) will provide new data about the distribution of various species of higher plants in many parts of Brazil. Obviously, sound biogeographical analyses depend on reliable data about the occurrence of species.

The importance of these collection efforts is evident in the number of new families (nine) that were added to the 72 of aquatic plants previously recorded for Northeastern Brazil and presented in Moura-Júnior et al. (2013). These are: Anemiaceae, Amaryllidaceae, Heliconiaceae, Hypoxidaceae, Iridaceae, Piperaceae, Polygalaceae, Sapindaceae and Vitaceae.

The noticeable presence of ruderal species is probably due to the fact that many aquatic environments were found within livestock raising areas, strongly associated with pasture grasses. Their presence in the aquatic environments is an indicative of irreversible processes of the beginning/intensification of alteration of the original native flora (Kufner et al. 2011). Species richness of Cyperaceae in aquatic environments in the Recôncavo basin of Bahia is another indicator of the anthropogenic influence on the native flora composition (Pivari et al. 2008, Bryson and Carter 2008). The study area is also characterized by the predominance of helophytic species. Helophytes and emergent species, occurring in intermediate environments, are not influenced by alterations in the physical and chemical properties of water (Meyer and Franceschinelli 2011). This may justify their greater presence, since seasonal changes in the aquatic environments do not interfere with their establishment.

In addition to expanding our knowledge of the floristic composition of the aquatic environments in the Recôncavo basin of Bahia, our study will also facilitate a long-term monitoring of aquatic environments and help

Table 1. List of the aquatic and marsh plants and their life forms (LF) for the Recôncavo basin of Bahia. HE = helophytes; EM = emergent; FF = free floating; FS = free submerged; FFL = fixed floating; and FSU = fixed-submerged. * ruderal species. ■ woody or subshrubby species.

Family/Species	LF	Voucher (HURB)	Family/Species	LF	Voucher (HURB)
Anemiaceae			Thelypteridaceae		
<i>Anemia</i> sp. 1	EM	2588	<i>Thelypteris interrupta</i> (Willd.) K.Iwats.	EM	1237
<i>Anemia</i> sp. 2	EM	6644	Acanthaceae		
<i>Anemia</i> sp. 3	EM	7967	<i>Hygrophila costata</i> Nees	HE	1329
Lycopodiaceae			<i>Justicia laevilinguis</i> (Nees) Lindau	EM	2472
<i>Lycopodium</i> sp.	HE	8339	<i>Justicia</i> sp.	EM	4988
Marsileaceae			<i>Nelsonia canescens</i> (Lam.) Spreng.	HE	1322
<i>Marsilea ancylopoda</i> A.Braun	FFL	1410	<i>Ruellia bahiensis</i> (Nees) Morong*	HE	2920
Pteridaceae			<i>Ruellia paniculata</i> L.	HE	1323
<i>Ceratopteris thalictroides</i> (L.) Brongn.	EM	1357	Alismataceae		
Pteridaceae			<i>Echinodorus macrophyllus</i> (Kunth) Micheli	EM	1502
<i>Pityrogramma calomelanos</i> (L.) Link	EM	10174	<i>Echinodorus palaefolius</i> (Nees & Mart.) J.F. Macbr.	EM	3912
Salviniaceae			<i>Hydrocleys martii</i> Seub.	EM	2340
<i>Azolla filiculoides</i> Lam.	FF	4394	<i>Hydrocleys nymphoides</i> (Willd.) Buchenau	FFL	4996
<i>Salvinia auriculata</i> Aubl.*	FF	1344	Amaranthaceae		
<i>Salvinia oblongifolia</i> Mart.	FF	1418	<i>Alternanthera brasiliana</i> (L.) Kuntze var. <i>villosa</i> (Moq.) Kuntze	HE	1576

Continued

Table 1. Continued.

Family/Species	LF	Voucher (HURB)
<i>Alternanthera philoxeroides</i> (Mart.) Griseb.*	HE	3957
<i>Alternanthera tenella</i> Colla*	HE	991
<i>Amaranthus spinosus</i> L.*	HE	4202
<i>Gomphrena celosioides</i> Mart.*	HE	6589
Amaryllidaceae		
<i>Hymenocallis caribaea</i> (L.) Herb.	HE	4419
<i>Hymenocallis littoralis</i> (Jacq.) Salisb.	HE	4418
Apiaceae		
<i>Eryngium</i> sp.	EM	1355
<i>Pimpinella anisum</i> L.	HE	430
Apocynaceae		
<i>Oxypetalum tubatum</i> Malme	EM	1496
Araceae		
<i>Pistia stratioides</i> L.*	FF	2583
<i>Lemna minuta</i> L.	FF	2573
<i>Montrichardia linifera</i> (Arruda) Schott	EM	10183
Araliaceae		
<i>Hydrocotyle leucocephala</i> Cham. & Schltdl.	EM	4143
<i>Hydrocotyle bonariensis</i> Lam.	EM	10032
Asteraceae		
<i>Acmella paniculata</i> (Wall. ex DC.) R.K.Jansen	HE	1020
<i>Ageratum conyzoides</i> L.*	HE	2010
<i>Barrosoa betonicaeformis</i> (DC.) R.M.King & H.Rob.	EM	1489
<i>Blanchetia heterotricha</i> DC.	HE	1008
<i>Centratherum punctatum</i> Cass.*	HE	1017
<i>Eclipta prostrata</i> (L.) L.*	HE	1549
<i>Emilia fosbergii</i> Nicolson*	EM	4153
<i>Emilia sonchifolia</i> (L.) DC. ex Wight	HE	10849
<i>Enydra anagallis</i> Gardner	HE	4126
<i>Erechtites hieracifolius</i> (L.) Raf. ex DC.*	HE	4117
<i>Galinsoga parviflora</i> Cav.	HE	3942
<i>Gamochaeta coarctata</i> (Willd.) Kerguélen*	HE	4121
<i>Melanthera latifolia</i> (Gardner) Cabrera	HE	4124
<i>Mikania micrantha</i> Kunth	HE	4118
<i>Platypodanthera melissifolia</i> (DC.) R.M. King & H.Rob.	HE	4152
<i>Pluchea sagittalis</i> (Lam.) Cabrera*	HE	2339
<i>Praxelis pauciflora</i> (Kunth) R.M.King & H.Rob.	HE	1534
<i>Sphagneticola trilobata</i> (L.) Pruski*	HE	1015
<i>Vernonanthura brasiliiana</i> (L.) H.Rob.	HE	1346
Asteraceae sp. 1	HE	1533
Asteraceae sp. 2	HE	1473
Asteraceae sp. 4	HE	10248
Begoniaceae		
<i>Begonia cucullata</i> Willd.*	HE	6657
<i>Begonia fischeri</i> Schrank*	HE	
Boraginaceae		
<i>Cordia superba</i> Cham. ■	HE	3467
<i>Heliotropium indicum</i> L.*	HE	2593
<i>Euploca procumbens</i> (Mill.) Diane & Hilger*	HE	4287
<i>Myriopus rubicundus</i> (Salzm. ex DC.) Luebert	HE	4178
<i>Varronia curassavica</i> DC.*	HE	6629
<i>Varronia multispicata</i> (Cham.) Borhidi	HE	10412
Cabombaceae		
<i>Cabomba furcata</i> Schult. & Schult.f.	FF	1413
Caryophyllaceae		
<i>Drymaria cordata</i> (L.) Willd. ex Roem. & Schult.*	HE	8977
Cleomaceae		
<i>Physostemon guianense</i> (Aubl.) Malme	HE	1435
<i>Tarenaya spinosa</i> (Jacq.) Raf.*	HE	4293

Family/Species	LF	Voucher (HURB)
Commelinaceae		
<i>Callisia filiformis</i> (M.Martens & Galeotti) D.R.Hunt	HE	435
<i>Commelina benghalensis</i> L.*	HE	2955
<i>Commelina diffusa</i> Burm.f.*	HE	1349
<i>Commelina obliqua</i> Vahl*	HE	3924
<i>Tinantia sprucei</i> C.B.Clarke	HE	4145
Convolvulaceae		
<i>Evolvulus glomeratus</i> Nees & Mart.	HE	2476
<i>Ipomoea asarifolia</i> (Desr.) Roem. & Schult.*	HE	4197
<i>Ipomoea</i> sp.	HE	6613
Cucurbitaceae		
<i>Melothria pendula</i> L.	HE	10411
Cyperaceae		
<i>Bulbostylis</i> sp.	HE	3930
<i>Cyperus articulatus</i> L.	EM	2734
<i>Cyperus haspan</i> L.	HE/EM	2698
<i>Cyperus hermaphroditus</i> (Jacq.) Standl.*	HE/EM	3474
<i>Cyperus iria</i> L.*	EM	4159
<i>Cyperus ligularis</i> L.	EM	3940
<i>Cyperus luzulae</i> (L) Retz.*	HE	4386
<i>Cyperus ochraceus</i> Vahl	HE	2695
<i>Cyperus rotundus</i> L.*	EM	2977
<i>Cyperus surinamensis</i> Rottb.*	HE/EM	1440
<i>Eleocharis acutangula</i> (Roxb.) Schult.*	EM	4389
<i>Eleocharis atropurpurea</i> (Retz.) J.Presl & C.Presl	HE	1474
<i>Eleocharis elegans</i> (Kunth) Roem. & Schult.*	EM	6591
<i>Eleocharis filiculmis</i> Kunth	HE/EM	1454
<i>Eleocharis geniculata</i> (L.) Roem. & Schult.	EM	4161
<i>Eleocharis interstincta</i> (Vahl) Roem. & Schult.*	EM	2585
<i>Eleocharis minima</i> Kunth	EM	1459
<i>Eleocharis mutata</i> (L.) Roem. & Schult.	EM	3945
<i>Eleocharis nudipes</i> (Kunth) Palla	EM	2464
<i>Eleocharis sellowiana</i> Kunth*	HE	8392
<i>Eleocharis</i> sp.	EM	2721
<i>Eleocharis</i> sp. nov.	HE	1430
<i>Fimbristylis autumnalis</i> (L.) Roem. & Schult.*	HE/EM	4384
<i>Fimbristylis complanata</i> (Retz.) Link	HE	1449
<i>Fimbristylis cymosa</i> R.Br.	HE	4390
<i>Fuirena umbellata</i> Rottb.*	EM	1446
<i>Kyllinga brevifolia</i> Rottb.*	HE	2717
<i>Kyllinga vaginata</i> Lam.	HE	1481
<i>Oxycaryum cubense</i> (Poepp. & Kunth) Lye	EM	4395
<i>Pleurostachys sparsiflora</i> Kunth	HE	3917
<i>Pycnus polystachyos</i> (Rottb.) P.Beauv.*	EM	1450
<i>Pycnus unioides</i> (R.Br.) Urb.	HE	2696
<i>Rhynchospora gigantea</i> Link	EM	4206
<i>Rhynchospora holoschoenoides</i> (Rich.) Herter	EM	1569
<i>Rhynchospora nervosa</i> (Vahl) Boeckeler*	EM	2981
<i>Rhynchospora tenuis</i> Link	EM	2477
<i>Rhynchospora</i> sp.	EM	1493
<i>Scleria bracteata</i> Cav.	EM	6632
<i>Scleria gaertneri</i> Raddi*	HE	1106
Eriocaulaceae		
<i>Tonina fluviatilis</i> Aubl.	EM	1538
Euphorbiaceae		
<i>Acalypha brasiliensis</i> Müll.Arg.	HE	4149
<i>Astraea lobata</i> (L.) Klotzsch*	HE	3452
<i>Caperonia palustris</i> (L.) A.St.-Hil.	HE	2592
<i>Cnidoscolus</i> sp.	HE	10813
<i>Croton heliotropiifolius</i> Kunth	HE	1428

Continued

Table 1. Continued.

Family/Species	LF	Voucher (HURB)
<i>Dalechampia coriacea</i> Klotzsch ex Müll.Arg.	HE	4199
<i>Euphorbia heterophylla</i> L.*	HE	2936
<i>Euphorbia hirta</i> L.*	HE	432
<i>Euphorbia hyssopifolia</i> L.*	HE	1105
<i>Microstachys corniculata</i> (Vahl) Griseb.	HE	10179
Fabaceae		
<i>Aeschynomene</i> sp. ■	HE	11030
<i>Aeschynomene filosa</i> Mart. ■	HE	1474
<i>Aeschynomene scabra</i> G.Don ■	HE	2490
<i>Aeschynomene sensitiva</i> Sw. ■	HE	6539
<i>Calopogonium</i> sp.	HE	7966
<i>Chamaecrista nictitans</i> (L.) Moench*	HE	10874
<i>Chamaecrista repens</i> (Vogel) H.S.Irwin & Barneby	EM	2485
<i>Crotalaria retusa</i> L.*	EM	4440
<i>Desmodium adscendens</i> (Sw.) DC.*	HE	3451
<i>Desmodium barbatum</i> (L.) Benth.	HE	10797
<i>Desmodium incanum</i> (Sw.) DC.*	HE	6537
<i>Desmodium uncinatum</i> (Jacq.) DC.*	HE	6540
<i>Dioclea virgata</i> (Rich.) Amshoff	HE	7207
<i>Macroptilium lathyroides</i> (L.) Urb.*	HE	6587
<i>Mimosa pigra</i> L.*	HE	3468
<i>Mimosa pudica</i> L.*	HE	1335
<i>Neptunia plena</i> (L.) Benth.*	HE	2465
<i>Rhynchosia minima</i> (L.) DC.	HE	1100
<i>Senna obtusifolia</i> (L.) H.S.Irwin & Barneby*	HE	4201
<i>Stylosanthes gracilis</i> Kunth*	HE	6611
<i>Stylosanthes guianensis</i> (Aubl.) Sw.*	HE	2478
<i>Stylosanthes macrocephala</i> M.B.Ferreira & Sousa Costa	HE	2489
<i>Stylosanthes scabra</i> Vogel	EM	4192
<i>Vigna luteola</i> (Jacq.) Benth.	HE	10909
<i>Zornia latifolia</i> Sm.	HE	6538
Gentianaceae		
<i>Coutoubea spicata</i> Aubl.	HE	7000
<i>Schultesia gracilis</i> Mart.	HE	6604
<i>Schultesia guianensis</i> (Aubl.) Malme	EM	1495
Haloragaceae		
<i>Myriophyllum aquaticum</i> (Vell.) Verdc.*	FSU	7204
Heliconiaceae		
<i>Heliconia psittacorum</i> L.f.	HE	6636
Hydrocharitaceae		
<i>Najas conferta</i> (A.Braun) A.Braun	FF/FS	2908
<i>Apalanthe granatensis</i> (Bonpl.) Planch.	FSU	6584
<i>Egeria densa</i> Planch.*	FSU	4120
<i>Limnobium laevigatum</i> (Humb. & Bonpl. ex Willd.) Heine	FF	10009
Hydroleaceae		
<i>Hydrolea spinosa</i> L.*	HE	2344
Hypoxidaceae		
<i>Hypoxis decumbens</i> L.*	HE	2657
Iridaceae		
<i>Cipura paludosa</i> Aubl.	HE	10840
<i>Trimezia martinicensis</i> (Jacq.) Herb.	HE	6638
Lamiaceae		
<i>Hyptis</i> sp. 1	HE	4127
<i>Hyptis</i> sp. 2	HE	3453
<i>Hyptis</i> sp. 3	HE	1338
<i>Leonotis nepetifolia</i> (L.) R.Br.*	HE	1577
<i>Marsypianthes chamaedrys</i> (Vahl) Kuntze	HE	10850
<i>Mesosphaerum pectinatum</i> (L.) Kuntze	HE	6607
<i>Rhaphiodon echinus</i> Schauer*	HE	434
Lamiaceae sp.	HE	2660

Family/Species	LF	Voucher (HURB)
Lentibulariaceae		
<i>Utricularia foliosa</i> L.	FS	2006
<i>Utricularia gibba</i> L.	FS	10860
Linderniaceae		
<i>Lindernia crustacea</i> (L.) F.Muell.	HE	6646
<i>Torenia thouarsii</i> (Cham. & Schltdl.) Kuntze	EM	2575
Loganiaceae		
<i>Spigelia anthelmia</i> L.*	HE	1472
Lythraceae		
<i>Ammannia latifolia</i> L.	HE	1348
<i>Cuphea brachiata</i> Koehne	HE	2470
<i>Cuphea pascuorum</i> Koehne	HE	1425
<i>Cuphea racemosa</i> (L.f.) Spreng*	HE	2007
<i>Cuphea strigulosa</i> Kunth	HE	2919
<i>Pleurophora anomala</i> (A. St.-Hil.) Koehne	HE	4125
<i>Rotala ramosior</i> (L.) Koehne	HE	4396
Malvaceae		
<i>Corchorus argutus</i> Kunth*	HE	2950
<i>Malachra</i> sp.	HE	10893
<i>Pavonia</i> sp.	HE	10180
<i>Peltaea obsita</i> (Colla) Krapov. & Cristóbal	HE	10160
<i>Sida rhombifolia</i> L.*	HE	4436
<i>Sida ulei</i> Ulbr.	HE	6649
<i>Sida</i> sp.	HE	1572
<i>Sidastrum micranthum</i> (A.St.-Hil.) Fryxell*	HE	7199
<i>Triumfetta semitriloba</i> Jacq.* ■	HE	10250
<i>Urena lobata</i> L.*	EM	1333
<i>Waltheria</i> sp.	HE	10160
<i>Wissadula amplissima</i> (L.) R.E.Fr.	HE	1107
Malvaceae sp.	HE	2912
Marantaceae		
<i>Calathea</i> sp.	HE	2895
Mayacaceae		
<i>Mayaca fluviatilis</i> Aubl.	EM	8344
<i>Mayaca longipes</i> Mart. ex Seub.	FS/FSU	11035
Melastomataceae		
<i>Clidemia hirta</i> D.Don ■	HE	7205
<i>Desmoscelis villosa</i> (Aubl.) Naudin	HE	10169
<i>Leandra</i> sp.	EM	10167
<i>Marcetia taxifolia</i> (A.St.-Hil.) DC.	HE	9381
<i>Pterolepis glomerata</i> (Rottb.) Miq.	HE	10794
<i>Tibouchina lhotzkyana</i> (C.Presl) Cogn.	HE	7206
<i>Rhynchanthera dichotoma</i> (Desr.) DC.	HE	98
Menyanthaceae		
<i>Nymphoides indica</i> (L.) Kuntze*	FFL	7197
Molluginaceae		
<i>Mollugo verticillata</i> L.*	EM	1441
Nymphaeaceae		
<i>Nymphaea</i> cf. <i>amazonum</i> Mart. & Zucc.	FFL	2724
<i>Nymphaea lingulata</i> Wiersema	FFL	1443
<i>Nymphaea pulchella</i> DC.	FFL	1417
<i>Nymphaea rudgeana</i> G.Mey	FFL	1464
Ochnaceae		
<i>Sauvagesia erecta</i> L.	HE	1490
Onagraceae		
<i>Ludwigia erecta</i> (L.) H.Hara	EM	4129
<i>Ludwigia hyssopifolia</i> (G.Don) Exell	HE	6612
<i>Ludwigia leptocarpa</i> (Nutt.) H.Hara*	HE	2906
<i>Ludwigia peploides</i> (Kunth) P.H.Raven	HE	3913

Continued

Table 1. Continued.

Family/Species	LF	Voucher (HURB)
<i>Ludwigia octovalvis</i> (Jacq.) P.H.Raven*	HE	1535
Orchidaceae		
<i>Pelexia</i> sp.	HE	10703
Orobanchaceae		
<i>Melasma melampyroides</i> (Rich.) Pennell	HE	10713
Oxalidaceae		
<i>Oxalis puberula</i> Nees & Mart.	HE	7968
Passifloraceae		
<i>Passiflora foetida</i> L.*	HE	10419
Phyllanthaceae		
<i>Phyllanthus stipulatus</i> (Raf.) G.L.Webster	EM	1478
Phytolacaceae		
<i>Microtea paniculata</i> Moq.*	HE	2897
Piperaceae		
<i>Peperomia pellucida</i> (L.) Kunth	HE	2584
<i>Piper caldense</i> C.DC.	HE	3460
<i>Piper</i> sp.■	HE	2927
Plantaginaceae		
<i>Achetaria ocymoides</i> (Cham. & Schltdl.) Wettst.	HE	1142
<i>Achetaria scutellarioides</i> (Benth.) Wettst.	HE	8349
<i>Angelonia salicariifolia</i> Bonpl.	HE	7211
<i>Bacopa gratioloides</i> (Cham.) Edwall	EM	1547
<i>Conobea scoparioides</i> (Cham. & Schltdl.) Benth.	HE	8350
<i>Mecardonia procumbens</i> (Mill.) Small	HE	2591
<i>Scoparia dulcis</i> L.*	HE	425
<i>Stemodia foliosa</i> Benth.	HE	2017
<i>Stemodia maritima</i> L.	HE	2660
<i>Stemodia</i> sp.	HE	4198
Poaceae		
<i>Andropogon bicornis</i> L.*	HE	2944
<i>Chloris</i> cf. <i>barbata</i> Sw.*	HE	1475
<i>Dichanthelium sciurotoides</i> (Zuloaga & Morrone) Davidse	HE	2018
<i>Digitaria</i> cf. <i>ciliaris</i> (Retz.) Koeler*	HE	437
<i>Echinochloa colona</i> (L.) Link*	HE	1476
<i>Echinochloa crusgalli</i> (L.) P.Beauv.	HE	2948
<i>Echinocloa</i> sp.	HE	2947
<i>Eragrostis ciliaris</i> (L.) R.Br.*	HE	10035
<i>Eragrostis hypnoides</i> (Lam.) Britton, Sterns & Poggenb.	HE	1480
<i>Hymenachne amplexicaulis</i> (Rudge) Nees*	EM	2652
<i>Hymenachne pernambucensis</i> (Spreng.) Zuloaga	HE	10415
<i>Leersia hexandra</i> Sw.*	HE	2589
<i>Leptochloa virgata</i> (L.) P.Beauv.*	HE	1421
<i>Luziola caespitosa</i> Swallen	HE	2943
<i>Megathyrsus maximus</i> (Jacq.) B.K.Simon & S.W.L.Jacobs	HE	2963
<i>Panicum aquaticum</i> Poir.*	HE	10030
<i>Paspalidium geminatum</i> (Forssk.) Stapf	EM	3938
<i>Paspalum paniculatum</i> L.*	HE	4146
<i>Paspalum millegrana</i> Schrad. ex Schult.	HE	4430
<i>Paspalum conjugatum</i> P.J.Bergius	HE	10249
<i>Rugoloa pilosa</i> (Sw.) Zuloaga	HE	3454
<i>Sacciolepis myuros</i> (Lam.) Chase	HE	1556
<i>Setaria parviflora</i> (Poir.) Kerguélen*	EM	2938
<i>Sporobolus indicus</i> (L.) R.Br.*	EM	2678
<i>Steinchisma hians</i> (Elliott) Nash	HE	1431
<i>Steinchisma laxum</i> (Sw.) Zuloaga	EM	1555
<i>Steinchisma decipiens</i> (Nees ex Trin.) W.V.Br.	EM	1340
<i>Trichanthecium cyanenscens</i> (Nees ex Trin.) Zuloaga & Morrone	HE	9370
<i>Urochloa</i> sp.	HE	1110

Family/Species	LF	Voucher (HURB)
Polygalaceae		
<i>Polygala paniculata</i> L.*	HE	1471
<i>Polygala</i> sp.	HE	1544
Polygonaceae		
<i>Polygonum ferrugineum</i> Wedd.	HE	10243
<i>Polygonum hispidum</i> Kunth	HE	1437
<i>Polygonum punctatum</i> Elliott	EM	7210
Pontederiaceae		
<i>Eichhornia crassipes</i> (Mart.) Solms	FF/EM	4291
<i>Eichornia heterosperma</i> Alexander	EM	10861
<i>Eichhornia paniculata</i> (Spreng.) Solms*	EM	4163
<i>Heteranthera multiflora</i> (Griseb.) C.N.Horn	EM	10864
<i>Heteranthera peduncularis</i> Benth.	EM	3955
<i>Heteranthera reniformis</i> Ruiz & Pav.*	EM	2733
<i>Heteranthera rotundifolia</i> (Kunth) Griseb.	EM	10017
Portulacaceae		
<i>Portulaca umbraticola</i> Kunt	HE	3941
<i>Talinum paniculatum</i> (Jacq.) Gaertn.*	HE	4443
Rubiaceae		
<i>Borreria ocymifolia</i> (Roem. & Schult.) Bacigalupo & E.L.Cabral	HE	1494
<i>Borreria scabiosoides</i> Cham. & Schltdl.	HE	2651
<i>Borreria verticillata</i> (L.) G.Mey.*	HE	2673
<i>Diodella apiculata</i> (Willd. ex Roem. & Schult.) Delprete	HE	2479
<i>Diodia macrophylla</i> K.Schum.	HE	9641
<i>Diodia saponariifolia</i> (Cham. & Schltdl.) K.Schum.	HE	9360
<i>Gonzalagunia dicocca</i> Cham. & Schltdl.	HE	1086
<i>Perama hirsuta</i> Aubl.	HE	9367
<i>Richardia grandiflora</i> (Cham. & Schltdl.) Steud.*	HE	2923
<i>Sabicea grisea</i> Cham. & Schltdl. ■	HE	6647
Rubiaceae sp.	HE	6649
Sapindaceae		
<i>Serjania</i> sp. 1	HE	1108
<i>Serjania</i> sp. 2	HE	2898
<i>Serjania</i> sp. 3	HE	1108
Solanaceae		
<i>Cestrum nocturnum</i> L. ■	HE	7195
<i>Physalis angulata</i> L.*	HE	1501
<i>Schwenckia americana</i> Rooyen ex L.	HE	1001
<i>Solanum palinacanthum</i> Dunal	HE	10846
<i>Solanum thomasiifolium</i> Sendtn. ■	HE	10237
Typhaceae		
<i>Typha latifolia</i> L.	HE	2727
Urticaceae		
<i>Boehmeria cylindrica</i> (L.) Sw.	HE	4148
<i>Pilea pubescens</i> Liebm.	HE	6639
Verbenaceae		
<i>Lantana camara</i> L.*	HE	1112
<i>Lippia</i> sp.	HE	3456
<i>Priva lappulacea</i> (L.) Pers.	HE	4445
<i>Stachytarpheta angustifolia</i> (Mill.) Vahl	HE	4188
<i>Stachytarpheta bicolor</i> Hook.f.	HE	2680
Vitaceae		
<i>Cissus albida</i> Cambess. ■	HE	3443
<i>Cissus spinosa</i> Cambess. ■	HE	7203
Xyridaceae		
<i>Xyris macrocephala</i> Vahl	EM	1498
<i>Xyris</i> sp.	EM	1455
Zingiberaceae		
<i>Hedychium coronarium</i> J.Koenig*	EM	2916

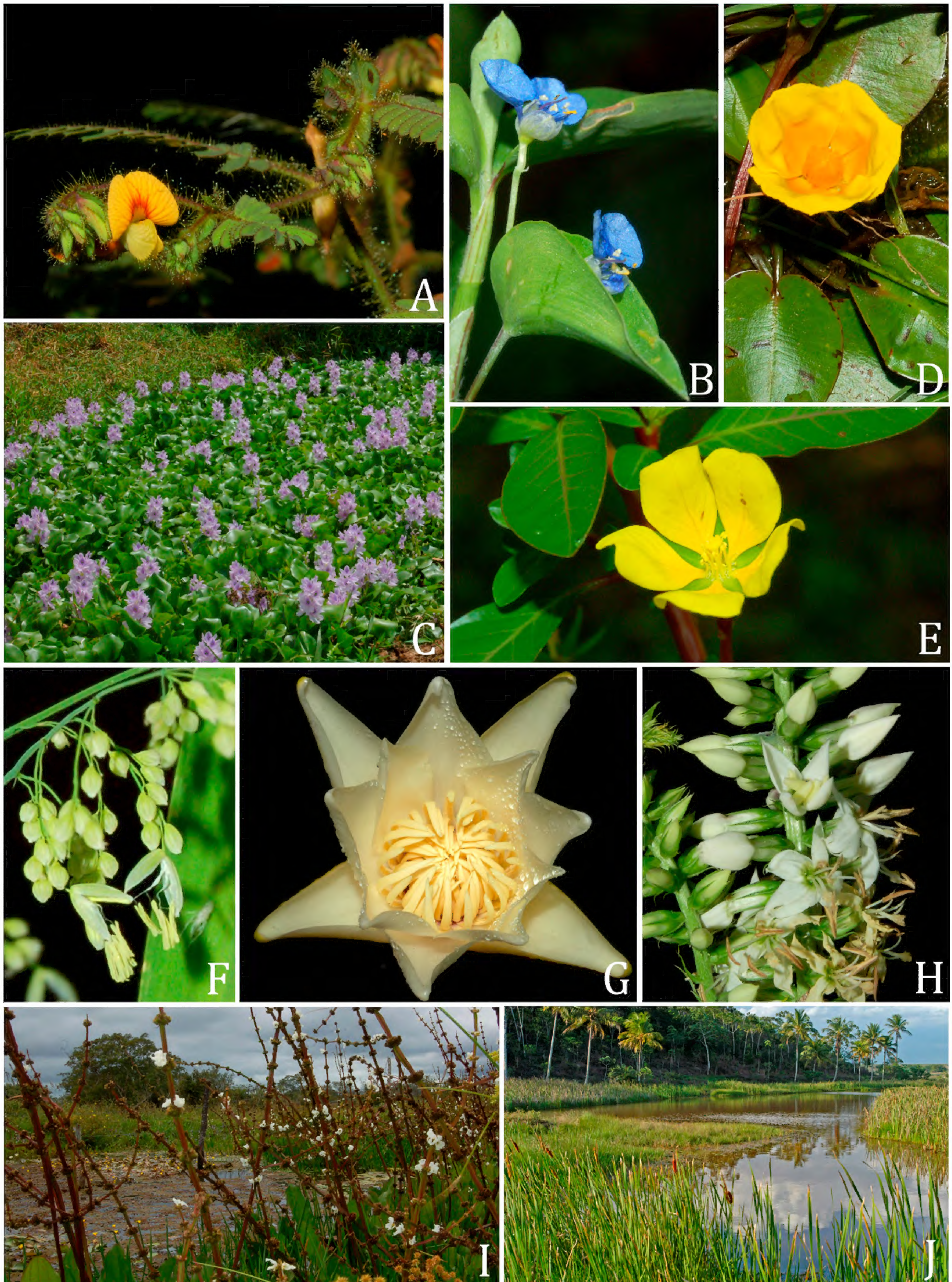


Figure 3. Aquatic and marsh plants photographed at the Recôncavo basin. **A:** *Aeschynomene* sp. (Fabaceae). **B:** *Commelina diffusa* (Commelinaceae). **C:** *Eichhornia crassipes* (Pontederiaceae). **D:** *Hydrocleys nymphoides* (Alismataceae). **E:** *Ludwigia peploides* (Onagraceae). **F:** *Luziola caespitosa* (Poaceae). **G:** *Nymphaea lingulata* (Nymphaeaceae). **H:** *Coutoubea spicata* (Gentianaceae). **I:** Lake in Sapeaçu municipality. **J:** River in Muritiba municipality. (Figures A-F, H-I: L.Y.S. Aona; figures G, J: V. Bittrich).

researchers in dealing with their water management, essential for the conservation and maintenance of any body of water.

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